

To quote from a letter from Joseph Ewan, who was his professor while he attended the University of Colorado, "his meticulous care, almost fanatical, in the handling of records, and extreme interest in assembling all the pertinent literature on a topic before committing himself by way of a botanical judgment" were among his most valuable assets. These characteristics are amply exemplified in his last published work, "Notes on the Genus *Nemacladus*" (Aliso, Vol. 4, pp. 139-147, 1958), in which two new species and new interpretations of already published taxa were published.

Tom's name is commemorated in *Phacelia strictiflora* Gray var. *Robbinsii* Constance (Contr. Gray Herb. 168:20, 1949), which was based on one of Tom's collections in Oklahoma.

Besides his membership in the California Botanical Society, he was a member of Sigma Xi, the Society for the Study of Evolution, and of the International Association for Plant Taxonomy.

Tom Robbins will long be missed by those whose good fortune it was to know him at all well.—RIMO BACIGALUPI, Jepson Herbarium, Department of Botany, University of California, Berkeley.

STUDIES IN THE PERENNIAL GENTIANS: G. NEWBERRYI AND G. TIOGANA¹

CHARLES T. MASON, JR.

Gentiana newberryi Gray is the name applied to a group of dwarf perennial gentians of Section *Pneumonanthe*, which occurs in the Sierra Nevada and Cascade Mountains of California and Oregon. The name is used in many manuals (Abrams, 1951; Jepson, 1925; Munz, 1959; Peck, 1941) to embrace not a single species but two species and a number of intermediate forms. While the author was studying the western perennial gentians under a National Science Foundation grant, the problem came to light, and an attempt is here made to resolve the difficulty.

Asa Gray described *Gentiana newberryi* from material collected in Oregon by Newberry, a member of the Williamson Pacific Railroad expedition of 1855. He first presented the new name in a hand-written description on the type sheet in the Gray Herbarium. Only the Newberry specimen was cited with this description. However, by the time the name was published (Gray, 1876), the circumscription was modified to include California material, and a Bolander collection from Mariposa County was added as a syntype.

Three other names have been applied to this complex. In 1931 Eastwood described *G. copelandii*, which she separated from *G. newberryi* on the "much broader leaves and dark purple flowers." The name *G. copelandii*, having been used previously by Greene (1904) and by Elmer

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(1915), was invalid, causing Eastwood to correct the name of this species to *G. eximia* (Eastwood, 1934). A third species, *G. tiogana*, was recognized in 1940 by Heller, who separated it from *G. newberryi* by its smaller size.

Of the three validly published names, *G. newberryi*, *G. eximia*, and *G. tiogana*, only the first has been accepted by students of the flora of California and Oregon. The present author, after studying many field and herbarium specimens, is convinced that two species should be recognized. They are both perennials with a rosette of leaves and with flowering stalks arising from the axils of last year's leaves. Each flowering stalk usually has a single flower, and the patterning on the flowers is the same; however, the two species can be separated by the following characters:

- Flowers 4.0–5.5 cm. long; corolla bright blue with 5 dark greenish stripes, the lobes 1.0–1.5 cm. long; plicae many-lobed with two long thin central lobes 0.7–0.9 cm. long; leaves broadly spatulate to suborbicular . . . *G. newberryi*
 Flowers 2.5–3.5 cm. long; corolla white or very pale blue with 5 dark greenish-brown stripes, the lobes 0.7–0.8 cm. long; plicae 0.4 cm., two-lobed with an occasional third or fourth lobe; leaves lanceolate to narrowly obovate *G. tiogana*

GENTIANA NEWBERRYI Gray, Proc. Am. Acad. 11:84. 1876. *Pneumonanthe newberryi* (Gray) Greene, Leafl. Bot. Obs. 1:71. 1904. *Dasystemphana newberryi* (Gray) Arth. Torreyia 22:30. 1922. *Gentiana copelandii* Eastw. Proc. Calif. Acad. Sci. Series 4, 20:150. 1931; non *Gentiana copelandii* Greene, 1904, or Elmer, 1915. *Gentiana eximia* Eastw. Leafl. West. Bot. 1:96. 1934.

Low rhizomatous perennial with a rosette of broadly oblong-spatulate to suborbicular leaves up to 6 cm. long and 2 cm. wide; flowering stems 1–5, decumbent to erect, 15 cm. long, from axils of last year's leaves; flowers 4.0–5.5 cm. long and usually 1 per stem; calyx tube 0.8–1.5 cm. long, the lobes 0.7–1.1 cm. long, lanceolate to elliptical; corolla convolute in the bud, funnellform after anthesis, 4.0–5.5 cm. long, bright blue with 5 dark purple stripes extending from the tips of the lobes to the base of the corolla, the lobes 1–1.5 cm. long, entire or erose, broadly rounded with yellow-green dots on the inner surface and extending down into corolla tube, the apices apiculate; plicae 0.7–0.9 cm. long, bifid with two long attenuate lobes and several secondary lateral projections; stamens maturing before the pistil, the anthers extrorse; style none; capsule ellipsoidal, 1.5 cm. long, the stipe 1.5 cm. long; seeds broadly winged all around.

Type. Crater Pass, west side Cascade Mountains, lat. 44°, Oregon, *Newberry* s.n. (GH). Type was seen.

Gentiana newberryi is known only from the Three Sisters in the Cascade mountain area of central Oregon, and from the Mount Eddy region in Siskiyou and Trinity counties, California. An unexplained distributional gap exists from northern California to central Oregon. A similar disjunct distribution is exhibited by *Limnanthes douglasii* R. Br.

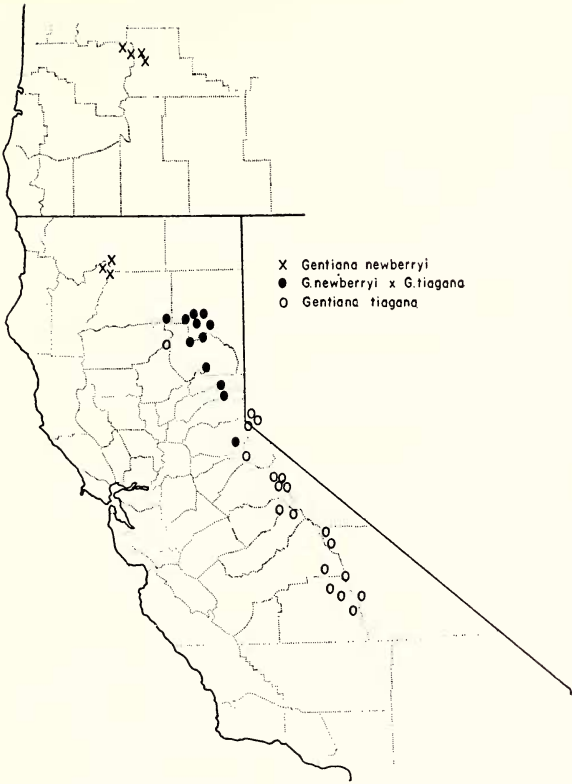


FIG. 1. Distribution of *Gentiana newberryi*, *G. tiogana*, and their hybrid in Oregon, California, and Nevada.

var. *douglasii*, which has the northern limit of its California distribution in Humboldt County and is again found in the Umpqua Valley, Douglas County, Oregon (Mason, 1952).

Representative specimens. OREGON. Deschutes County: Three Creeks Meadow, *Brandt & Steward 6985* (ID, UTC), *Ellis & C. Mason 1712*; meadow near Three Creeks Lake, *Whited 478* (WS), *Ellis & C. Mason 1711*; Fremont's Crossing of Tumalo Creek, *Whited 479a* (WS). Lane County: 5 miles west of McKenzie Pass, *Campbell 17497* (CAS); Hand Lake, 4 miles west of Lane-Deschutes county line, *T. & C. Mason 1791*.

CALIFORNIA. Siskiyou County: Mount Eddy, *Copeland 3878* (CAS), *Eastwood 2037* (type of *G. copelandii* Eastw., CAS.). Trinity County: Morris Meadow, Stuart Fork, *Alexander & Kellogg 5525* (UC); edge of Bull Lake, *Parker* in 1947 (DS).

GENTIANA TIOGANA Heller emend. C. T. Mason. *G. tiogana* Heller, *Leafl. West. Bot.* 2:221-222. 1940.

Low rhizomatous perennial with a rosette of obovate to spatulate leaves ca. 4 cm. long and 1 cm. wide; flowering stems 1 or 2, decumbent to erect, 5-7 cm. long, from the axils of last year's leaves; flowers 2.5-3.5

cm. long, usually 1 per stem; calyx tube 0.6–1.0 cm. long, the lobes 0.6–1.0 cm. long, lanceolate to elliptical; corolla convolute in the bud, funnel-form after anthesis, 2.5–3.5 cm. long, white or very light blue with 5 greenish-brown stripes extending from the tips of the lobes to the base of the corolla, the lobes 0.7–0.8 cm. long, entire or erose, narrow with yellow-green dots on the inner surface and extending down into corolla tube, the apices apiculate; plicae 0.4 cm., with 2 large lobes and an occasional third or fourth smaller lateral lobe; stamens maturing before the pistil, the anthers extrorse; capsule ellipsoidal, 1.0–1.2 cm. long, the stipe 1.0 cm. long; seeds broadly winged all around.

Type. Shore of a lakelet outside Yosemite National Park, Tioga Pass, Mono County, California, *Heller 15453* (WTU #79272. Isotypes, CAS, DS, NY, UC, WTU). The type specimen was not seen, but the information was transmitted by letter from C. L. Hitchcock. Isotypes from California Academy of Sciences, Dudley Herbarium, and University of California were seen.

Heller's labels agree on the collection number, the date, and that the collection was made outside Yosemite Park boundary. They vary to some degree on the other data presented. The county is listed as either Mariposa or Mono. As the park boundary is also the county line, "outside the park" would be Mono County. The distance outside the park varies from a few yards to one-fourth mile, and the elevation ranges from 9900 to 9940 feet. The labels also state, "south of Tioga Pass entrance"; the park boundary at that particular point extends east and west so that south of the entrance would be inside, not outside, the park. Heller probably considered the general direction of travel from Mono Lake to the Tioga Pass entrance through Leevining Canyon as west; therefore, to the left would be south. In the area to the east of the road at the Tioga Pass entrance is a meadow with a number of lakelets, and it undoubtedly is in this area that Heller made his collection.

The specific epithet *tiogana* was applied by Heller to specimens which, because of their smaller size, he considered distinct from the Sierra Nevada material recognized as *Gentiana newberryi*. This small form has been collected several times from the higher elevations and may warrant varietal recognition, but this author does not consider it distinct enough to be separated as a species; consequently Heller's epithet becomes the first applied to this group and must be used, and his description has been here emended to include the larger forms.

Representative specimens. CALIFORNIA. Inyo County: Big Pines Lake, *Howell 24123* (CAS); Mosquito Flat, Rock Creek, *Halperin 605* (CAS), *Ferris & Lorraine 11086* (DS); Heart Lake, Rock Creek Basin, *Peirson* in 1933 (DS, UC), *Peirson 9483* (COLO); Kearsarge Pass Trail west of Independence, *Alexander & Kellogg 3291* (DS, UC); Brown Lake, *Raven & Stebbins 254* (CAS, UC); Cottonwood Lakes, *Alexander & Kellogg 3316* (DS, UC, UTC). Tulare County: Crabtree Meadows, *H. M. & G. Hall 8442* (UC); Lost Canyon, *Howell 17787* (CAS); Rock Creek, *Howell 25515* (CAS, UC, UTC, WS); Army Pass, *Howell 26045* (CAS); Sequoia-Mount Whitney trail, *Sisson & Kobs* in 1928 (COLO); Humphrey Basin, *Moran 490* (DS). Fresno County: Hilgard Branch, Bear Creek, *Raven 7872* (CAS);

Humphrey Basin west of Mount Humphreys, *C. Sharsmith 3149* (UC). Madera County: Iron Creek, *Raven 3809* (CAS). Mariposa County: Mount Hoffman, *Rodin 885* (UC). Mono County: Slate Creek, Hall Natural Area, *Clausen 920* (DS, UC), *C. Mason 1514*; Dana Meadow, Tioga Pass, *Rowntree* in 1931 (CAS); $\frac{1}{2}$ mile upstream from Camp Tioga along Slate Creek, *C. Mason 1512*; southwest end Little Virginia Lake, *Hendrix 604* (UC); Soda Springs, Tuolumne Meadows, *Eastwood 625* (CAS); Bourland Meadows, *Belshaw 81* (UC); Dana Plateau, northwest of Mount Dana, *C. Sharsmith 2331* (UC); White Mountain, Mount Conness Range, *H. Mason 11339* (UC); Ten Lakes Basin, *H. Sharsmith 1329* (UC); near Dog Lake, *Howell 20434* (CAS). Alpine County: meadow 3 miles west of Lake Alpine, *C. Mason 1610*. Eldorado County: Benwood Meadows, Camp Echo, *Heller 12264* (CAS, COLO, DS, UC); Dicks Lake, Lake Tahoe, *Alexander & Kellogg 3508* (UC); Meyers Station, *Clemens* in 1920 (CAS). Butte County: Jonesville, Spring Creek, *Copeland* in 1931 (UC). NEVADA. Washoe County: 3 miles south Mount Rose, *Hitchcock & Martin 5542* (DS, UC, UTC, WS); Galena Creek, south base Mount Rose, *Hitchcock & Martin 5522* (DS, UC, UTC); Mount Rose, *Heller 9970* (CAS, DS, MONTU).

Naturally and artificially produced hybrids among the gentians are well-known (Mason, 1959), and a number of herbarium specimens from northern California show evidence of hybridization and introgression between *G. tiogana* and *G. newberryi*. Three collections from Eldorado County (Wrights Lake, *Johannsen 452*, UC; $\frac{1}{2}$ mile north of Wrights Lake, *Robbins 1355*, CAS, UC; and Echo Summit, *Howell 22974*, CAS) have the characteristics of *G. tiogana* except that the plicae tend to be long and narrow.

Several collections from Nevada, Sierra, Plumas, Lassen, and Shasta counties in California have characteristics of both species. Specimens from Sage Hen Creek (*H. Mason 14472*, UC), and Independence Lake (*Floyd* in 1925, CAS, *Alexander & Kellogg 5160*, UC), of Nevada County, and Webber Lake, Sierra County (*Dudley* in 1894, DS) have stem length, leaf size but not shape, and plicae lobing which approach those of *Gentiana newberryi*. The flower size is intermediate, ranging from 3.5–4.3 cm. on the collections from Independence Lake, and 3.8–4 cm. on the other two collections. The plicae are of the larger type found in *G. tiogana*, and the green and white flower color of that species is specified on Mason's collection. Possibly the larger size of the leaves and stems is the result of ecological rather than genetic factors.

A sheet of specimens from Mount Elwell, Plumas County (*Wicks 2889*, UC), has flowers and leaves approaching those of *G. newberryi*. The flowers are 4–4.5 cm. long and the calyx lobes are large and elliptic. The plicae, although multilobed, are the large type of *G. tiogana*. The flower color is not specified, but the specimens appear dark as though there may be some blue factors present. One plant on the sheet is quite different from the others; it has the smaller flowers, smaller leaves, white color, and heavy plicae of *G. tiogana*. The presence of the two types in the same collection gives good evidence that both are present in the same area so that hybridization might occur between the two species.

Several collections from northern Plumas County (Big Meadows, *Coombs* in 1912, CAS, UC, *Austin 399*, UC; Prattville, *Coombs* in 1906, CAS), southeastern Shasta County (Lassen's Peak, *Brewer 2175*, UC;

upper King's Creek Meadow, *Hoover 4612*, UC), and southwestern Lassen County (Susanville, *Safford* s.n., UC; Mountain Meadows, *Austin* in 1879, UC; Hog Flat, *Stebbins* et al 3998, UC; Harvey Valley Spring, *Whitney 1505*, UC; a mile east of Westwood, *Heller 15341*, DS, UC) show evidence of introgression. Of particular interest are the two collections from Big Meadow which have several flowers per stem. This multiple flower condition is uncommon in either of these parent species, but it is seen on some collections by Lemmon which are affixed to the type sheet of *G. newberryi*. Undoubtedly these Lemmon collections were made from this northern California area, although the data on the label are vague and incomplete. The Brewer collection from Mount Lassen and Safford's collection from Susanville have very small plants and flowers and show more of the characters of *G. tiogana* than *G. newberryi*.

The two species under consideration are usually separated by altitudinal differences. Most collections of *G. newberryi* have come from areas between 4000 and 6500 feet in elevation, but one specimen from Bull Lake, Trinity County, California (*Parker* in 1947, DS) is listed as 7380 feet. *Gentiana tiogana* frequently is found above timberline, and specimens from 12,000–13,000 feet are not uncommon. The lowest elevation noted for a collection of *G. tiogana* is 7160 feet at Jackass Meadow, Fresno County (*Peirson 12880*, CAS).

The specimens cited as having characteristics of both species have been collected from areas which, for the most part, are intermediate in elevation between the usual requirements of the two parents. The collection of specimens from "a mile east of Westwood," *Heller 15341*, is cited as elevation 5000 feet, and these plants are predominantly of the *G. newberryi* type. On the other hand the collection from Lassen's Peak, *Brewer 2175*, was made at 8000 feet, and these specimens have the majority of their characters similar to *G. tiogana*. This overlap in the altitudinal distribution of intermediate forms might also be regarded as evidence that *G. newberryi* and *G. tiogana* hybridize in northern California.

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CHROMOSOME COUNTS IN THE SECTION
SIMIOLUS OF THE GENUS MIMULUS
(SCROPHULARIACEAE). IV.

BARID B. MUKHERJEE AND ROBERT K. VICKERY, JR.

This report¹ on the determination of chromosome numbers in the section *Simiolus* of the genus *Mimulus* is part of a long range investigation into the evolution of species in *Mimulus* (Vickery, 1951). The chromosome numbers and configurations presented in this article indicate a lack of cytological differentiation between several of the currently accepted species (Pennell, 1951) of the section *Simiolus*. Also they reveal the presence of aneuploidy in different populations of two other species, and, lastly, they fill an important gap in the previously indicated (Mukherjee and Vickery, 1959) polyploid series that extends from North to South America.

Essentially the same method of bud fixation was employed as in the previous investigation (Mukherjee and Vickery, 1959), i.e., fixation in two parts absolute ethanol to one part glacial acetic acid saturated with ferric acetate, followed by staining of the anthers in iron-aceto-carmin. Work now in progress indicates that there may be possible improvements in this schedule. Each chromosome number determination is based on counts from an average of approximately eight pollen mother cells. Camera lucida drawings were made for three or four figures for each count and, in addition, photomicrographs were taken of many of the configurations. Herbarium specimens of each culture have been or will be deposited in the Garrett Herbarium of the University of Utah (UT).

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